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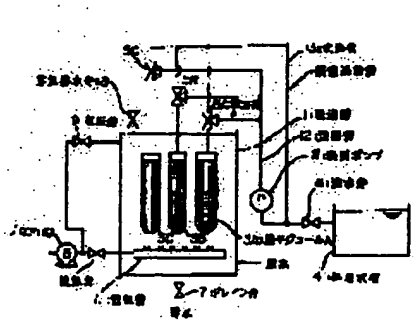
(54) MEMBRANE FILTER

(57)Abstract:
PURPOSE: To easily and efficiently wash a membrane without removing a membrane module from equipment by feeding treated water from one of the plural membrane modules arranged in parallel directly to the remaining membrane modules to wash them.
CONSTITUTION: Plural membrane modules 3 are immersed in a tank filter 1 and they are each connected to a treated water tank 4 by an outflow pipe 12 through three-way valves 3 and a suction pump 2 and an outflow valve 6 are arranged in the middle of the way. And on filtering, an exhaust and drain valve 8 is opened and a valve in a blower system is closed and the three- way valves 5 are turned to the outflow system side and the outflow valve is opened and an original liquid is fed to be sucked by the suction pump 2 to perform filtration and the treated liquid is sent to the tank 4, and on washing the tank filter 1, the three-way valve 5A is turned to the circulating system side and the three-way valves 5B, 5C are turned to the outflow system side and the outflow valve 6 is closed and the treated water from the membrane modules 3B, 3C is injected directly into the membrane module 3A by the pump 2 through the three-way 5A to wash the module 3A.



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* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

CLAIMS

[Claim(s)]
[Claim 1] Membrane filtration equipment characterized by using one or the treated water from some membrane modules as wash water which washes the direct remaining membrane modules in the juxtaposition-existence of the membrane filtration equipment with which two or more dispositions of the membrane module are carried out, or the membrane filtration equipment with which the membrane module is arranged.
[Claim 2] Membrane filtration equipment characterized by furnishing in the juxtaposition-existence of the membrane filtration equipment with which two or more dispositions of the membrane module are carried out, and the membrane filtration equipment with which the membrane module is arranged so that adjustment of the concentration of a chemical, mixing, circulation, and neutralization can be performed within this filter, and performing chemical washing, without removing this membrane module from this equipment.

[Translation done.]

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(54) **Title of the Invention:** Membrane Filter Device

(21) **Application No.:** 3-358229
(22) **Application Date:** December 27, 1991

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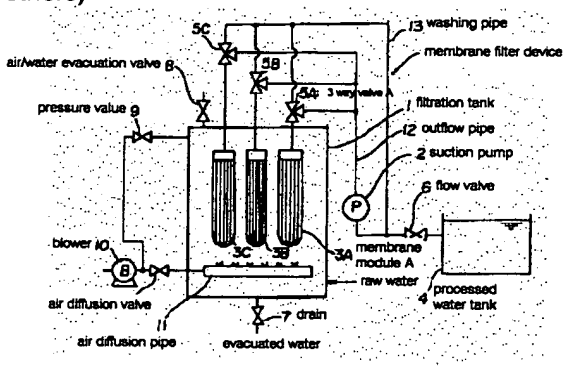
(57) **[Abstract]**

[Object] To wash a membrane simply and efficiently in a membrane filtration process; and to wash a membrane without removing a membrane module from a filter device when washing with a chemical solution is necessary.

[Constitution] In a membrane filter device provided with a plurality of membrane modules, or an array of membrane filter devices, at least provided with external-pressure membrane modules, membrane filtered water is directly used for washing water by an arrangement of a constant-flow pump and valves.



[CLAIMS]

[Claim 1] In a membrane filter device provided with a plurality of membrane modules, or an array of membrane filter devices provided with membrane modules, the membrane filter device characterized by using processed water from one or some of the membrane modules directly as washing water for washing the remaining membrane modules.

[Claim 2] In a membrane filter device provided with a plurality of membrane modules, or an array of membrane filter devices provided with membrane modules, the membrane filter device characterized by providing equipment that allows for adjustment of the concentration of a chemical solution, mixing, circulation and neutralization within the filter device, and performing chemical washing without removing said membrane module from said device.

[Detailed Description of the Invention]

[0001]

[Field of Industrial Application] The present invention relates to a membrane filtration device for filtering suspensions contained in raw water such as river water, well water, lake water, human waste water, industrial water and effluent.

[0002]

[Prior Art] In terms of common membrane filtration processes, in both precision filtration processes and ultrafiltration processes, the membrane modules used for membrane filtration can be classified into external-pressure membrane modules, for filtering liquid from the exterior of the membrane to the interior thereof, and internal- pressure membrane modules, for conversely filtering liquid from the interior of the membrane to the exterior thereof. Furthermore, in terms of the method for feeding the raw water to the membrane module for filtering, there exists a method wherein the raw water is forced into the membrane by way of pressure and a method wherein the raw water permeates the membrane by way of suction.

[0003] In the membrane filter washing process, basic washing is performed by washing with processed water and/or bubbling using air. When washing with processed water, by means of equipment such as that shown in FIG. 4, processed water is first collected in a processed water tank and pressurized by means of a pump or some other method, and the processed water is sent to the membrane module so as to wash it. Air washing is performed by disposing an air diffusion pipe under the membrane module at the bottom of the membrane filter device or the like, and air bubbles are released so as to wash the membrane module. Furthermore, methods are effective wherein, after washing with processed water and/or washing by way of bubbling with air, all of the washing wastewater is drained from the membrane device [*sic*].

[0004] If the processed water is first accumulated in the processed water tank, and washing is performed with the processed water, dirt and the like in the processed water tank flows into the interior of the membrane, which may result in reverse soiling. Furthermore, in cases where the raw water contains soluble manganese, the soluble substance passes through the membrane, so that soluble manganese gets into the processed water tank; and if chlorine is added to the processed water tank as a disinfectant, the soluble manganese is oxidized and solidifies. This solid may soil the interior of the membrane.

[0005] If soiling of the membrane module progresses so that it is no longer possible to recover permeation flow rates by way of ordinary cleaning such as bubbling and washing with processed water, chemical washing is performed. Chemical washing is such that the membrane is immersed for a long period of time in a washing solution, such as aqueous caustic soda, a hydrochloric acid solution, or an aqueous solution of sodium hypochlorite the concentration thereof having been [suitably] adjusted, or a chemical solution is circulated through the membrane. Because it is necessary to neutralize the waste solution after circulating a chemical solution or performing chemical washing, the common procedure is one wherein the membrane module is removed from the filter device, [the washing] is performed in a separate chemical washing device, and the membrane module is once again installed in the original filter device. However, actually removing the membrane module from the filter device and once again mounting it in the original filter device is extremely labor-intensive and time-consuming.

[0006]

[Problems to Be Solved by the Invention] Objects of the present invention are to solve the problems in the membrane filter washing processes described above, and to wash membranes simply and efficiently. Furthermore, [an object of the present invention] is to wash membranes without removing the membrane module from the filter device, even when washing with a chemical solution is necessary.

[0007]

[Means for Solving the Problems] The problems described above can be solved by development of the filter device of the present invention. That is to say, 1) in a membrane filter device provided with a plurality of membrane modules, or an array of membrane filter devices provided with membrane modules, the membrane filter device characterized by using processed water from one or some of the membrane modules directly as washing water for washing the remaining membrane modules.

[0008] And 2) in a membrane filter device provided with a plurality of membrane modules, or an array of membrane filter devices provided with membrane modules, the membrane filter device developed so as to be characterized by providing equipment that allows for adjustment of the concentration of a chemical, mixing, circulation and neutralization within the filter device, and performing chemical washing without removing said membrane module from said device.

[0009] Furthermore, the membrane filtration method of the present invention can be performed by disposing a plurality of membrane modules, or by placing a plurality of membrane filter devices in alignment and interconnecting these by piping or the like. In cases where it is convenient to use an open type membrane module, it is advantageous to use a method wherein the raw water is caused to permeate the membrane by way of suction, by combining the membrane module with a suction pump.

[0010] In the membrane filter washing process, in order to prevent soiling from the processed water side, rather than using processed water that has first been accumulated in the processed water tank, it is most suitable to use the processed water as washing water directly. Using the processed water as washing water directly can be performed by using a plurality of membrane modules (or membrane filter devices) and switching the processed water, by way of a valve, from a membrane module serving for filtration (or from a membrane filter device; hereinafter [the reference to] membrane filter devices is omitted) so as to send the water to the membrane module which is to be washed.

[0011] In the filter device of the present invention, membrane washing is performed without removing the membrane module from the device; furthermore this is characterized by adjusting the concentration of chemicals, mixing, circulating and neutralizing within the device.

[0012] The process of the present invention, wherein the membrane is washed without removing the membrane module

from the device and adjustment of the concentration chemicals, mixing, circulation and neutralization are performed within the filter device, comprises the steps of, first, filling the interior of the device with raw water or processed water; adding a predetermined amount of chemical; diluting the chemical within the device using the bubbling function; washing the membrane by circulating the diluted chemical within the device, while this passes through the filter; and after washing is complete, adding a neutralization chemical and neutralizing the solution within the device using the bubbling function so as to complete the washing process.

[0013] In the process described above, a method is described wherein the chemical is directly added to the interior of the filter device and diluted, but this may also be performed by another method, specifically one wherein the chemical is diluted to a predetermined concentration in a separate chemical tank, and that diluted chemical solution is suctioned into the filter device by way of, for example, an ejector, or fed in by way of a feed pump.

[0014] In terms of the pump used in the membrane filter device of the present invention, when the membrane module is immersed in the filtration tank as an open type membrane module, membrane filtration is performed by way of a suction filtration method, using a suction pump, as already described above. However, in the membrane filter device of the present invention, it is possible that the membrane module washing is performed using the same pump as is used for filtration. Furthermore, when operations such as adjusting the concentration of the chemical, mixing, circulation and neutralization are performed within the device, constant-flow pumping characteristics are required. Accordingly, it is preferable that the pump used in the membrane filtration device of the present invention be a pump having constant-rate characteristics and capable of changing between pressure and suction operation, such as a positive displacement screw pump. However, the pump used in the membrane filter device of the present invention is not limited to a constant-rate pump, and ordinary pumping pumps can be used by providing the constant-rate characteristics using valves or the like, and changing between pressure and suction.

[0015] In terms of the chemical used when washing the membrane module with a chemical, caustic soda, sodium hypochlorite, hydrogen peroxide, hydrochloric acid and many other well-known chemicals can be used.

[0016] Furthermore, the equipment for using a plurality of membrane modules and sending the processed water from a membrane module serving for filtration to a membrane module (or membrane filter device) which is to be washed by switching valves, as described above, and the equipment for adjusting the concentration of chemicals, mixing, circulation and neutralization, can be provided in the same filter device, so that the objects set forth above in 1) and 2) can be achieved in a single filter device.

[0017] Moreover, one variant on the membrane filter device of the present invention is a membrane filter system wherein, if a plurality of membrane filter devices are present, this plurality of membrane filter devices are interconnected between each other by piping or the like, and while some of these membrane filter devices perform the membrane filtration process, another portion of these membrane filter devices perform the membrane washing process.

[0018] Furthermore, one variant of the membrane filter device of the present invention is one wherein, when a plurality of membrane filter devices are present in the same manner as described above, equipment for adjusting the concentration of chemicals, mixing, circulation and neutralization is provided in only some of these membrane filtration devices, and the chemical preparation equipment and the like in this portion of the membrane filter devices is used for the chemical washing of the membranes in the other portion of the membrane filter devices. Various other variants are possible by combining the aforementioned processed water washing method and chemical washing method, and all of these belong to the category of the membrane filter device of the present invention.

[0019]

[Embodiments] Hereinafter the present invention is described by setting forth a specific embodiment, but the following description is [only] one example of the membrane washing of the present invention, and the present invention is not limited thereby.

[0020] (Embodiment 1) The membrane filter device of the present invention shown in FIG. 1 is such that a filtration tank 1 in this device is filled with raw water and three external-pressure membrane modules are immersed in this filtration tank 1. The three external-pressure membrane modules 3 (3A, 3B, 3C) are connected to a processed water tank 4 by way of an outflow pipe 12, via corresponding three-way valves 5 (5A, 5B, 5C), and a suction pump 2 and an outflow valve 6 are disposed midway.

[0021] The structure of the three-way valves 5 is as shown in FIG. 3, and it is possible to switch between the outflow system and the circulation system by operating the valves. An air diffusion pipe 11 is provided at the bottom of the filtration tank 1; air is sent to the air diffusion pipe 11 by a blower 10 so as to supply air bubbles to the filter modules 3, which are washed by the air. Furthermore, water can be evacuated by way of a drain valve 7 by closing an air diffusion valve and an air/water evacuation valve 8 at the top of the filter tank 1, opening a pressure valve, operating the blower, and feeding pressurized air to the filtration tank 1 so as to pressurize the interior of the membrane filter device.

[0022] When filtration is performed, the air/water evacuation valve 8 is opened, the blower system valves are closed, the three-way valve 5 is set to the outflow system, the outflow valve is opened, and suction filtration is performed with the suction pump 2, while supplying raw water, so that the filtered processed water is sent to a processed water tank 4. When washing of the filtration tank 1 is performed, the three-way valves 5 are normally set to the circulation system, and processed water is fed from the process water tank by the pump for washing, but in the membrane filter device of the present invention, as already described above, in order to avoid soiling from the processed water side, washing is not performed with processed water from the processed water tank, but rather the system is one wherein the processed water is used for the washing water directly. In other words, in the device in FIG. 1, for example, the three-way valve 5A is switched to the circulation system, the three-way valves 5B and 5C are set to the outflow system, the outflow valve 6 is closed, the processed water from the membrane modules 3B and 3C is fed to the membrane module 3A directly, by way of the three-way valve 5A, using the suction pump 2, and washing is performed.

[0023] The three-way valves 5A, 5B and 5C are successively switched to the circulation system, and washing is performed for each of the membrane modules that have been switched to the circulation system. It is preferable that the suction pump 2 be a positive displacement pump wherein the pumping rate does not change, even if there are changes in the suction force as a result of switching valves. Note that two two-way valves may also be used in place of the three-way valve.

[0024] In the membrane filter device in FIG. 1, a method of washing the membrane modules one by one is shown, but if a plurality of membrane filter devices are present, the membrane filter system may be such that some of these membrane filter devices perform the membrane filtration process so as to output processed water, and this processed water is sent to the membrane modules in the other portion of the membrane filter devices so as to wash those membranes.

[0025] In a draining process following completion of

membrane washing, it is preferable that, with the drain valve 7 open, the air/water evacuation valve is closed, and with the pressure valve open, the blower 10 is activated so as to evacuate the water in the filtration tank 1 with the air-source pressure.

[0026] A case wherein washing is performed using chemicals is described by way of FIG. 2. In FIG. 2, the membrane filtration tank 1 has been filled with raw water. In cases where a chemical solution is added directly to the membrane filtration tank 1 and diluted to a predetermined chemical concentration in the membrane filtration tank 1, the volume of the membrane filtration tank 1 is known, and so an amount of chemical solution that will produce the necessary concentration for washing is added, and the concentration of the chemical solution within the tank is made uniform by way of bubbling air from the air diffusion pipe at the bottom of the tank.

[0027] In cases where the raw water is dirty, if it is unsuitable to add [the chemical] directly to the raw water in the tank, after draining all of the raw water from within the tank, the tank can be filled with processed water that is fed from the processed water tank, and the predetermined concentration of washing solution can be achieved in the same manner as described above.

[0028] When the predetermined concentration of washing solution has been achieved, washing operations begin by circulating the washing solution within the tank. In order to circulate the washing solution within the tank, one of the three-way valves, for instance 20A of membrane module 15A, from among the membrane modules 15, is set to the circulation system, and the other three-way valves 20B and 20C are set to the outflow system. The processed water pump 18 is started, washing solution is suctioned from membrane modules 15B and 15C and fed into the interior of the membrane of the membrane module 15A, so as to permeate the membrane. This washing solution is circulated until the filter resistance value of the membrane in the membrane module 15A reaches that of the product when new, whereafter the three-way valves are switched so that the three-way valve 20B of the membrane module 15B is set to the circulation system and the other three-way valves 20C and 20A are set to the outflow system, so that all of the membrane modules are washed.

[0029] Once washing with the chemical solution is complete, a chemical is added to the tank for neutralization, and circulation is continued with the liquid in the tank passing through the three membrane modules, and [when] it is confirmed that the liquid in the tank has been neutralized by measuring the pH, all of the washing procedures are complete. Once washing of the membrane modules has been completed, normal membrane filtration operations can be immediately recommenced. In the foregoing description, a case is described wherein a chemical solution is added directly to the membrane filtration tank 1 and diluted to a predetermined chemical concentration in the membrane filtration tank 1, but other methods can be used, such as a method wherein the chemical solution is suctioned from a chemical tank 23 using an ejector 22, and the chemical solution is added to the membrane filtration tank 1 by passing through the membrane module 15, or a method wherein [the chemical] is fed in using a separate chemical feed pump.

[0030] The membrane filter device can be used in sewage treatment processes using activated sludge treatment, allowing sludge to be efficiently separated and concentrated. In other words, the membrane module is immersed in a processing tank or in a sedimentation pond, and the sewage is separated into supernatant water and concentrated sludge by way of suction-type membrane filtration, so as to concentrate the sludge, which allows for increases in the efficiency of activated sludge treatment processes.

[0031] When the membrane filter device is used in sewage treatment processes using activated sludge treatment, it is advantageous to use the washing system of the present invention. In the case of sewage treatment processes using activated sludge treatment, it is not suitable to add chemicals directly to the processing tank, and it is preferable that the chemical be diluted in a chemical tank, and then added to the processing tank.

[0032]

[Effects of the Invention] The present invention is such that, in a membrane filter device provided with a membrane module, by disposing a pump, and preferably a constant-rate pump, and valves, membrane washing can be performed using membrane processed water as the washing water directly. Furthermore, by providing this membrane filter device with a chemical tank as necessary, it is possible to efficiently perform membrane washing with a chemical solution without removing the membrane module from the device.

[Brief Description of the Drawings]

[FIG. 1] FIG. 1 is a process flowchart of the washing of a membrane module with the membrane filter device of the present invention.

[FIG. 2] FIG. 2 is a process flowchart of the washing of a membrane module with a chemical solution, with the membrane filter device of the present invention.

[FIG. 3] FIG. 3 is a diagram for describing the flow routes of three-way valves used in the membrane filter device of the present invention.

[FIG. 4] FIG. 4 is a process flowchart of membrane filtration using a pressure pump.

[Explanation of the Reference Numerals]

1	filtration tank
14	filtration tank
2	suction pump
15A	membrane module A
3A	membrane module A
15B	membrane module B
3B	membrane module B
15C	membrane module C
3C	membrane module C
16	blower
4	processed water tank
17	air diffusion pipe
5A	three-way valve A
18	processed water pump
5B	three-way valve B
19	processed water tank
5C	three-way valve C
20A	three-way valve A
6	outflow valve
20B	three-way valve B
7	drain valve
20C	three-way valve C
8	air/water evacuation valve
21	washing valve
9	pressure valve
22	ejector
10	blower
23	chemical tank
11	air diffusion pipe
24	outflow pipe
12	outflow pipe
25	washing pipe
13	washing pipe

FIG. 1

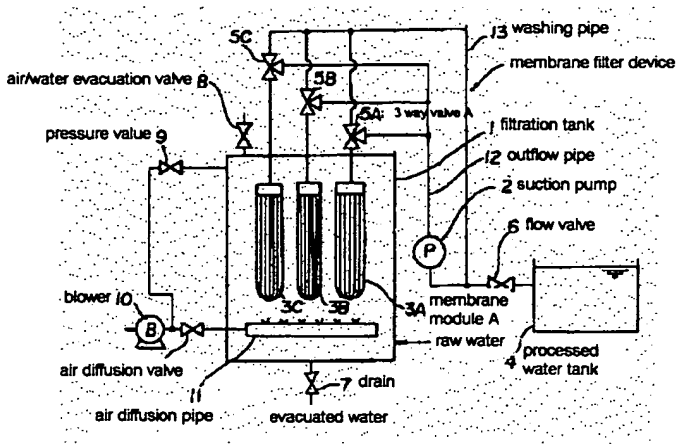


FIG. 2

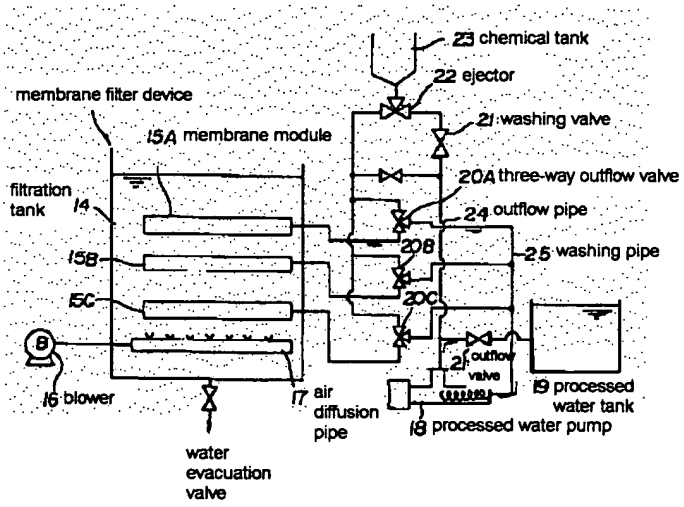


FIG. 3

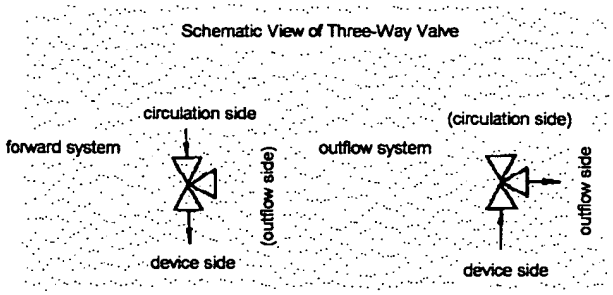
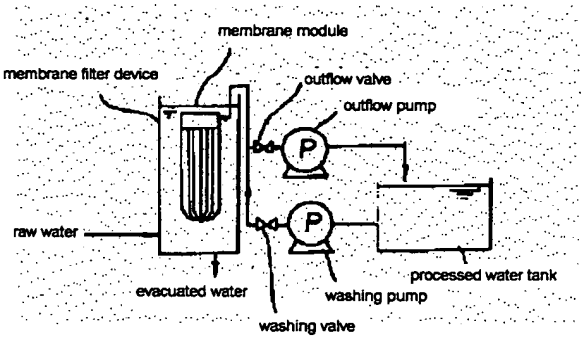


FIG. 4



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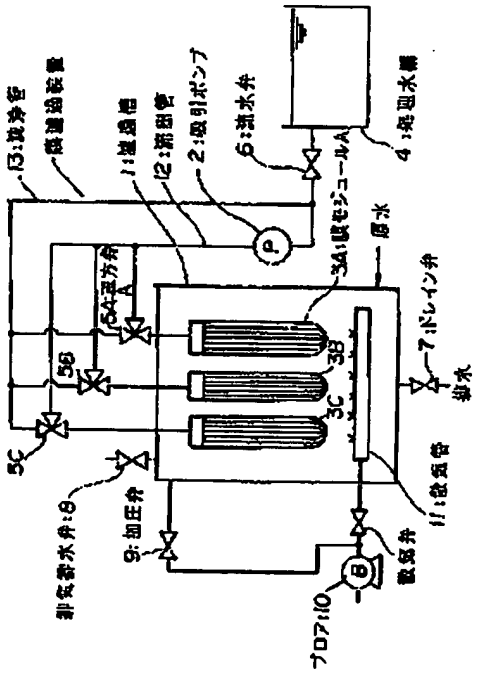
(54)【発明の名称】　膜濾過装置

(57)【要約】

【目的】　膜濾過工程において簡単でかつ効率よく膜の洗浄を行うことにあり、また薬液による洗浄が必要な時、膜モジュールを濾過装置から取り外すことなく膜の洗浄を行うことにある。

【構成】　膜モジュールが複数配備されている膜濾過装置、あるいは少なくとも外圧型膜モジュールが配備されている膜濾過装置の並列的存在において、定量ポンプと、弁とを配置して膜処理水を直接洗浄水として使用する。



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【特許請求の範囲】

【請求項1】　膜モジュールが複数配備されている膜濾過装置、あるいは膜モジュールが配備されている膜濾過装置の並列的存在において、一つあるいは一部の膜モジュールからの処理水を直接残りの膜モジュールを洗浄する洗浄水として使用することを特徴とする膜濾過装置。

【請求項2】　膜モジュールが複数配備されている膜濾過装置、膜モジュールが配備されている膜濾過装置の並列的存在において、該濾過装置内で薬品の濃度の調整、混和、循環および中和を行えるように設備し、薬品洗浄を該膜モジュールを該装置から取り外すことなく行うことを特徴とする膜濾過装置。

【発明の詳細な説明】

【0001】

【産業上の利用分野】本発明は河川水、井水、湖沼水、し尿、用水及び廃水などの原水に含まれる懸濁物を濾過するための膜濾過装置に関する。

【0002】

【従来の技術】一般的な膜濾過工程では、精密濾過工程においても、限外濾過工程においても、膜濾過に使用する膜モジュールを分類すると、膜の外側から内側に液体を濾過する外圧型膜モジュールとその反対に膜の内側から外側に液体を濾過する内圧型膜モジュールとに分類される。また、濾過のために膜モジュールに原水を送る方式としては、原水を加圧的に膜に圧入させる方式と吸引的に膜を透過させる方式とがある。

【0003】膜濾過の洗浄工程では、洗浄は処理水洗浄および／あるいは空気を用いたバブリングによって行うのが基本である。処理水洗浄の場合、図4に示したような設備によって、処理水を一旦処理水槽に貯留し、ポンプあるいは他の方法で加圧して処理水を膜モジュールに送って洗浄を行う。空気洗浄は膜濾過装置の底部で膜モジュールの下部に散気管を設置するなどして、空気の気泡を送って膜モジュールの洗浄を行う。また、処理水洗浄および／あるいは空気を用いたバブリングによって洗浄した後、洗浄廃水は膜装置から完全にドレンする方法が効果的である。

【0004】処理水を一旦処理水槽に滞留させ、処理水洗浄を行うと、処理水槽の汚れなどが膜内部に流入して逆汚染することがある。また、原水に溶解性マンガンが含まれているような場合、溶解性物質は膜を通過するので溶解性マンガンは処理水槽に入り、処理水槽に消毒用の塩素が添加されると酸化されて溶解性マンガンが固形化する。この固形物が膜内部を汚染することもある。

【0005】膜モジュールの膜の汚染が進行して、バブリングや処理水洗浄などの通常の洗浄で、透過水量が回復しなくなった場合には薬品洗浄を行う。薬品洗浄は濃度を調整した苛性ソーダ水溶液、HCl液あるいは次亜塩素酸ソーダ水溶液などの洗浄液に膜を長時間浸すか、薬液を膜を通して循環させるかで行う。薬液の循環、または薬品洗浄後の廃液の中和が必要なため、膜モジュールを濾過装置から取り外して別途の薬品洗浄装置で行い、再度もとの濾過装置に取り付けるのが一般的な工程である。しかしながら、膜モジュールを濾過装置から取り外したり、再度もとの濾過装置に取り付けたりすることを実際に行うことは非常に労力や時間を要することである。

2

【0006】

【発明が解決しようとする課題】本発明の目的は上記膜濾過の洗浄工程における問題点を解消し、簡単でかつ効率よく膜の洗浄を行うことにある。また、薬液による洗浄が必要な時も膜モジュールを濾過装置から取り外すことなく膜の洗浄を行うことにある。

【0007】

【課題を解決するための手段】上記課題は本発明の濾過装置を開発することによって解決することができる。すなわち、1）膜モジュールが複数配備されている膜濾過装置、あるいは膜モジュールが配備されている膜濾過装置の並列的存在において、一つあるいは一部の膜モジュールからの処理水を直接残りの膜モジュールを洗浄する洗浄水として使用することを特徴とする膜濾過装置。

【0008】および、2）膜モジュールが複数配備されている膜濾過装置、膜モジュールが配備されている膜濾過装置の並列的存在において、該濾過装置内で薬品の濃度の調整、混和、循環および中和を行えるように設備し、薬品洗浄を該膜モジュールを該装置から取り外すことなく行うことを特徴とする膜濾過装置を開発することにある。

【0009】また本発明の膜濾過方法は膜モジュールが複数配備されているか、膜モジュールが配備されている膜濾過装置が複数並列して存在し、相互に配管などで連結されていることによって可能となる。開放型の膜モジュールの使用が便利な場合には、膜モジュールと吸引ポンプとの組み合わせで原水を吸引的に膜を透過させる方式とすることが有利である。

【0010】膜濾過の洗浄工程においては、処理水側からの汚染を防止するためには膜濾過した処理水を一旦処理水槽に溜めて用いるのではなく、処理水をそのまま洗浄水として使用することが最適である。処理水を直接洗浄水として使用することは、複数の膜モジュール（または膜濾過装置）を使用して、濾過の役割りの膜モジュール（または膜濾過装置、以下膜濾過装置は省略する）の処理水を弁の切替えによって洗浄すべき膜モジュールに送水することによって行われる。

【0011】本発明の濾過装置では膜モジュールを装置から取り外すことなく膜の洗浄が行え、また装置内で薬品の濃度の調整、混和、循環および中和を行えることが特徴である。

【0012】膜モジュールを装置から取り外すことなく膜を洗浄し、濾過装置内で薬品の濃度の調整、混和、循

環および中和を行う本発明の工程は、先ず装置内を原水または処理水で充満し、規定量の薬品を添加して、バブリング機能を利用して薬品を装置内で希釈し、洗浄機能で希釈薬品を膜に通しながら装置内に循環して膜を洗浄し、洗浄が終了した後、中和用の薬品を添加してバブリング機能を利用して装置内の液を中和し、洗浄工程を終了する工程よりなる。

【００１３】上記工程においては薬品を直接濾過装置内に添加して希釈する方式について記載したが、別の方式、すなわち別途薬品槽で薬品を規定濃度に希釈してその希釈薬品液を例えばエジェクターにより濾過装置に吸引注入させる方式や注入ポンプで注入する方式で行ってもよい。

【００１４】本発明の膜濾過装置に使用するポンプは、膜モジュールが濾過槽中に開放型の膜モジュールとして浸漬されているとき、膜濾過は既に上記した通り吸引ポンプを使用して吸引濾過方式で行われる。しかしながら本発明の膜濾過装置では膜モジュールの洗浄が濾過に使用するのと同一のポンプで行われることもある。また装置内で薬品の濃度の調整、混和、循環および中和などの操作が行われる場合には定量送液性が要求される。従って、本発明の膜濾過装置に使用するポンプとしては容積ネジポンプのような加圧および吸入方式に可変でかつ定量性のあるポンプが望ましい。しかしながら、本発明の膜濾過装置に使用するポンプは定量ポンプに限定されることはなく、弁などを用いて定量性の付与や加圧および吸入の変更を行って、通常の送液ポンプも使用することができる。

【００１５】膜モジュールを薬品を用いて洗浄する場合に用いる薬品としては、苛性ソーダ、次亜塩素酸ソーダ、過酸化水素水、塩酸、その他公知の多くの薬品が使用できる。

【００１６】また、上記複数の膜モジュールを使用して、濾過の役割りの膜モジュールの処理水を、弁の切替えによって洗浄すべき膜モジュール（または膜濾過装置）に送水する設備と、薬品の濃度の調整、混和、循環および中和を行う設備とを同一濾過装置に設備して、上記１）および２）に記載の目的を同一濾過装置で行うことも可能である。

【００１７】しかしまた、複数の膜濾過装置が存在する場合には、その複数の膜濾過装置の間に配管などによって相互に連結して、その内一部の膜濾過装置は膜濾過工程を行っている時点で、他の一部の膜濾過装置が膜洗浄の工程を行っているという膜濾過方式も本発明の膜濾過装置の１変形である。

【００１８】さらにまた、上記同様に複数の膜濾過装置が存在する場合に、その内一部の膜濾過装置にのみ薬品の濃度の調整、混和、循環および中和を行う設備を設置して、他の一部の膜濾過装置の膜の薬品洗浄には前記一部の膜濾過装置の薬品調整設備などを利用して薬品洗浄を行うことも本発明の膜濾過装置の１変形である。その他種々の変形が上記処理水洗浄方式と薬品洗浄方式の組み合わせで考えられるがそれらはすべて本発明の膜濾過装置の範疇に属する。

【００１９】

【実施例】以下、具体的実施例を示して本発明を説明するが、以下の説明は本発明の膜洗浄の１例であり本発明がこれに限定されるものではない。

【００２０】（実施例－１）図１に示した本発明の膜濾過装置では、該装置の濾過槽１は原水で充満されており、その濾過槽１中に３本の外圧型膜モジュールが浸漬されている。３本の外圧型膜モジュール３（３Ａ、３Ｂ、３Ｃ）はそれぞれ三方弁５（５Ａ、５Ｂ、５Ｃ）を経由して流出管１２で処理水槽４に連結されており、その途中に吸引ポンプ２と流出弁６が配置されている。

【００２１】三方弁５の構造は図３に示したようで、弁の操作で流出系と循環系とに切替えられる。濾過槽１の底部には散気管１１が設けられており、ブロア１０で散気管１１に空気を送り、濾過モジュール３に気泡を供給して空気による洗浄ができる。また散気弁と濾過槽１の上部の排気排水弁８を閉じて、加圧弁を開き、ブロアを運転して濾過槽１に加圧空気を送り膜濾過装置内を加圧してドレン弁７より排水できるようになっている。

【００２２】濾過を行う時は、排気排水弁８を開き、ブロア系の弁は閉じ、三方弁５を流出系とし、流出弁を開き、原水を供給しながら吸引ポンプ２で吸引して濾過を行い、濾過した処理水を処理水槽４に送る。濾過槽１の洗浄を行う時には、通常は三方弁５を循環系とし、処理水槽からポンプで処理水を送って洗浄するが、本発明の膜濾過装置では既に上記した通り処理水側からの汚染を防止するために処理水槽からの処理水で洗浄するのではなく、処理水をそのまま洗浄水として使用する方式となっている。すなわち、図１の装置では例えば三方弁５Ａを循環系に切替え、三方弁５ＢおよびＣは流出系とし、流出弁６は閉じて、膜モジュール３ＢおよびＣからの処理水を吸引ポンプ２で直後三方弁５Ａを経て膜モジュール３Ａに注入して洗浄する。

【００２３】三方弁５Ａ、５Ｂ、５Ｃは順次循環系に切替え、それぞれ循環系に切替えられた膜モジュールを洗浄する仕組みとなっている。吸引ポンプ２は弁の切替えによって吸引圧が変動しても送水量は変動しない容積ポンプとすることが望ましい。なお、三方弁にかえて二方弁を２個用いても構わない。

【００２４】図１に膜濾過装置では、各膜モジュール毎の洗浄方法を示したが、複数の膜濾過装置が存在する場合には、その内一部の膜濾過装置は膜濾過工程を行っていて、処理水が流出しているその処理水を他の一部の膜濾過装置の膜モジュールに送ってその膜洗浄を行なう膜濾過方式が行える。

【００２５】膜洗浄が終了後ドレン工程では、ドレン弁

7を開の状態とし、排気排水弁を閉じ、加圧弁を開の状態としてブロア10を駆動すると濾過槽1内の水は空気源の圧力で排水するのが好ましい。

【0026】図2を使用して、薬品を用いて洗浄する場合について説明する。図2において、膜濾過槽1は原水で満たされた状態にあるとする。膜濾過槽1に直接薬液を添加して膜濾過槽1中で所定の薬品濃度に希釈する場合には、予め膜濾過槽1の容積は知られているので、洗浄に必要な濃度になるような量の薬液を添加し、槽底の散気管からの空気のバブリングによって槽中の薬液の濃度を均一にする。

【0027】もし、原水が汚染状態にあり、槽中の原水に直接添加することが不適当な場合には槽内の原水の全量をドレン後処理水槽の処理水を槽内に送水し充満させて、上記同様にして所定濃度の洗浄液を得る。

【0028】所定濃度の洗浄液が得られたら、槽中の洗浄液を循環しての洗浄操作にはいる。槽中の洗浄液を循環するためには、膜モジュール15の一つ例えば15Aの三方弁20Aを循環系の状態とし、他の三方弁20Bおよび20Cは流出系の状態とする。処理水ポンプ18を起動し、洗浄液を膜モジュール15Bおよび15Cから吸引し膜モジュール15Aに膜の内側より注入して膜を透過させる。この洗浄液の循環を膜モジュール15Aの膜の濾過抵抗値が新品の状態になるまで行い、その後膜モジュール15Bの三方弁20Bを循環系の状態とし、他の三方弁20Cおよび20Aは流出系の状態というように三方弁を切り換えてすべての膜モジュールを洗浄する。

【0029】薬液による洗浄が終了したら、槽中に中和用の薬品を添加して槽中の液の3本の膜モジュールを通しての循環を続け、槽内の液が中和されたことをpH測定によって確認して、洗浄の全工程を終了する。膜モジュールの洗浄が終了したら、直ちに通常の膜濾過処理を再開することができる。上記説明は膜濾過槽1に直接薬液を添加して膜濾過槽1中で所定の薬品濃度に希釈する場合について説明したが、他の方式として、薬品槽23からエジェクタ22を使用して薬液を吸引し、膜モジュール15を通して膜濾過槽1に薬液を添加する方式や別途薬液注入ポンプを使用して注入する方式も行うことができる。

【0030】活性汚泥処理法による汚水処理工程に膜濾過装置を利用して効率よく汚泥を分離・濃縮することができる。すなわち、処理槽中あるいは沈殿池中に膜モジュールを浸漬して吸引方式で膜濾過で汚泥を上澄水と濃縮汚泥とに分離して汚泥を濃縮し、活性汚泥処理工程の効率化をはかることができる。

【0031】活性汚泥処理法による汚水処理工程に膜濾過装置を利用した場合に、本発明の洗浄方式を利用すると便利である。活性汚泥処理法による汚水処理工程の場合には処理槽中に直接薬品を添加することは不適当で、薬品槽中で薬品を希釈して、処理槽中に添加することが望まれる。

【0032】

【発明の効果】本発明は膜モジュールが配備されている膜濾過装置において、ポンプ好ましくは定量ポンプと、弁とを配置して、膜処理水を直接洗浄水として使用する膜洗浄を行うことができる。また、この膜濾過装置に、必要ならば薬品槽を設けて、薬液による膜洗浄を膜モジュールを装置から取り外すことなく、効率よく行うことができる。

【図面の簡単な説明】

【図1】図1は本発明の膜濾過装置による膜モジュールを洗浄する工程のフロー図。

【図2】図2は本発明の膜濾過装置により、膜モジュールを薬液により洗浄する工程のフロー図。

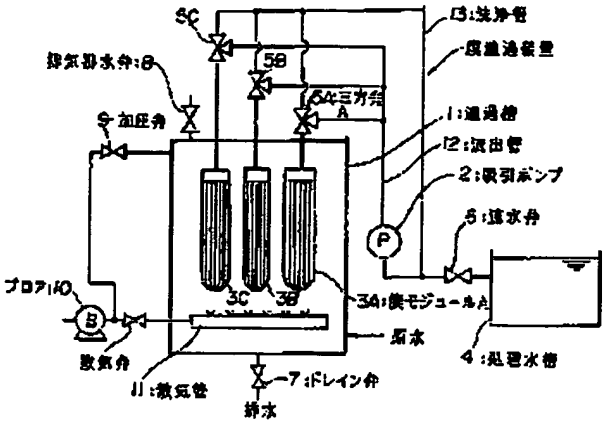
【図3】図3は本発明の膜濾過装置に使用する三方弁の流路を説明する図。

【図4】図4は加圧ポンプによる膜濾過の工程フロー図。

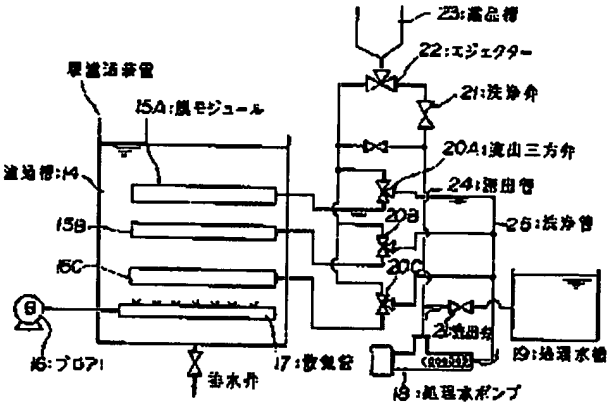
【符号の説明】

1	濾過槽	14	濾過槽
2	吸引ポンプ	15A	膜モジュールA
3A	膜モジュールA	15B	膜モジュールB
3B	膜モジュールB	15C	膜モジュールC
3C	膜モジュールC	16	ブロア
4	処理水槽	17	散気管
5A	三方弁A	18	処理水ポンプ
5B	三方弁B	19	処理水槽
5C	三方弁C	20A	三方弁A
6	流出弁	20B	三方弁B
7	ドレン弁	20C	三方弁C
8	排気排水弁	21	洗浄弁
9	加圧弁	22	エジェクター
10	ブロア	23	薬品槽
11	散気管	24	流出管
12	流出管	25	洗浄管
13	洗浄管		

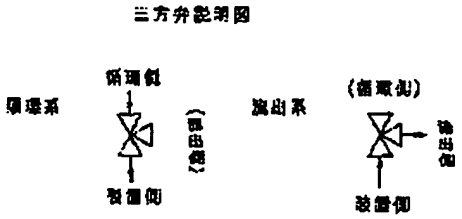
【図1】


5C
13:洗浄管
排気排水弁:8
5B
膜濾過装置
5A:三方弁
A
9:加圧弁
1:濾過槽
12:流出管
2:吸引ポンプ
5:原水弁
3C
3B
3A:膜モジュール
ブロア:10
原水
4:処理水槽
散気弁
11:散気管
7:ドレイン弁
排水

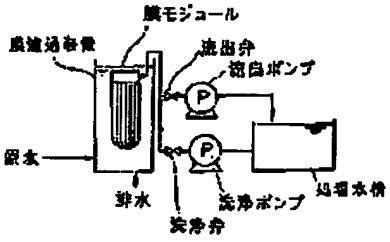
【図2】


23:薬品槽
22:エジェクター
膜濾過装置
15A:膜モジュール
21:洗浄弁
20A:流出三方弁
濾過槽:14
24:流出管
15B
20B
25:洗浄管
15C
20C
6:ブロア
17:散気管
排水弁
19:処理水槽
18:処理水ポンプ

【図3】


三方弁説明図
循環側
環境系
(循環側)
流出系
(流出側)
流出側
循環側

【図4】


膜モジュール
膜濾過装置
流出弁
流出ポンプ
原水
排水
洗浄ポンプ
処理水槽
洗浄弁